Remarks

Examiner Venhl is thanked for the thorough Office Action.

In the Specification

The specification has been reviewed and amendments made to correct typographical and editorial errors. No new matter has been added.

In the Claims

A marked up version/copy of amended claims in attached at the back.

Claim objections and amendments

Claims 1, 11 and 19 are amended as kindly suggested by the examiner.

Claims 4, 12, 13 and 20, 21 are amended to delete "medium".

Note that all amendments to the claims are for clarification purposes and not in response to prior art rejections.

Claims 2, 3, and 12 are canceled.

Claim 9 is amended to add the limitations of claim 4.

Claim 11 is added to clarify that the etch forms a first opening. See Fig 2 and 4.

Claim 14 is amended to depend from claim 11.

Claim 18 is amended to add the limitations of claim 13.

Claim 19 is added to clarify that the etch forms a first opening. See Fig 2 and 4.

Claim 26 is amended to correct a typo.

New claims 27 – 29 are added.

No new matter is added.

CLAIM REJECTIONS:

Rejection Of Claims 1, 5, 6, 8 and 10 Under 35 U.S.C. § 102(e) as being anticipated by Ye et al. al.

The rejection of claims 1, 5, 6 8 and 10 Under 35 U.S.C. § 102(e) as being anticipated by Ye et al. al. is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the amendments

Amended claim 1 is non-obvious

Amended claim 1, step (c)(1) limits the invention to a NH_3 and CO or O_2 gasses.

The Office Action dated 9/9/2002, posits that Ye suggest this. However, Ye teaches away from the claim 1 step c1's NH_3 and CO or O_2 etch gas by teaching (1) (See Ye, col. 12, line 20-21) a O_2 and N_2 alpha FC layer etch. Secondly, Ye teaches (2) a (See Ye col. 22, lines 41-42,) a NH_3 only etch of FLARE TM low K layer. There is no suggestion to modify Ye's 2 separate etches/embodiments. Therefore Ye teaches away from amended claim 1 step C1.

Claims 5, 8 and 10 are non-obvious

Claims 5, 8 and 10 are non-obvious over the cited art because they depend from non-obvious amended claim 1.

Rejection of claims 11, 14, 15 and 17 under 35 U.S.C. § 102e as being anticipated by Ye et al.

The rejection of claims 11, 14, 15 and 17 under 35 U.S.C. § 102e as being anticipated by Ye et al. is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the amendments.

Amended parent Claim 11, step (c) claims etch gases of "NH_3 and H_2 etch gasses and flowing O_2 or CO gasses. "

The Office Action p. 4 cites Ye et al. in 2 instances (col. 12, L 20-21 and col. 222, lines 41-42) as suggesting using claim 11's etch gases of NH_3 and H_2 etch gasses and flowing O_2 or CO gasses. " . However, Ye teaches away from the claim 11 step c1's NH_3 and H_2, and CO or O_2 etch gas by teaching (1) (See Ye, col. 12, line 20-21) a O_2 and N_2 alpha FC layer etch. Secondly, Ye teaches (2) (See Ye col. 22, lines 41-42,) a NH_3 only etch of FLARE

TM low K layer. There is no suggestion to modify Ye's 2 separate etches/embodiments. Therefore Ye teaches away from amended claim 11 step C1.

Claims 14 15 and 17

Claims 14 15 and 17 depend from non-obvious amended claim 11.

Rejection of claims 2-4 and 12-13 under 35 U.S.C. § 103 as being unpatentable over Ye et al. and Bhardwag et al.

The rejection of claims 2-4 and 12-13 under 35 U.S.C. § 103 as being unpatentable over Ye et al. and Bhardwag et al. is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the amendments.

Claims 2 and 3 are canceled.

Dependant Claim 4 contains specific result dependent parameters for the etch. These parameters are not suggested by the prior art. No other cited reference suggests that adding CO or O_2 will reduce that polymer buildup and reduce sidewall bowing. See spec. p. 8, section D. Also, Claim 4 specifies a "medium plasma power" that is not suggested by the references. See Spec. p. 9 Section E.

Claim 12 is canceled.

Dependent claim 13 is non-obvious.

Dependent claim 13 is non-obvious. Dependant Claim 12 contains specific result dependent parameters for the etch. These parameters are not suggested by the prior art. No other cited reference suggests that adding CO or O_2 will reduce that polymer buildup and reduce sidewall bowing. See spec. p. 8, section D. Also, Claim 13 specifies a "medium plasma power" that is not suggested by the references. See Spec. p. 9 Section E.

Rejection of claims 7 and 16

Claims 7 and 16 depend from non-obvious parent claims as discussed above.

Rejection of claims 9 and 18

Amended claims 9 and 18 are non-obvious for the reasons discussed above for their respective parent claims. Moreover, claim 9 and 18 claim the exact process that create straight walled openings.

Rejection of claims 19 22-24 and 25 under 35 U.S.C. § 103a as being unpatentable voer Ye and Ngo

The rejection of claims 19 22-24 and 25 under 35 U.S.C. § 103a as being unpatentable over Ye and Ngo is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the amendments.

Parent claim 19 step c1, claims an etch with only NH_3 and N_2 etch gasses.

The combination of Ye et al. and Ngo et al. is improper.

The combination of Ye et al. and Ngo et al. is improper for the purpose cited in the Office Action because neither reference suggests they be combined and this can be only done by hindsight.

Even if combined Ye and Ngo do not met claim 19.

Even if combined Ye and Ngo do not met claim 19 step c1. Yu col 22, lines 39 to 42 teaches a NH_3 only etch. This teaches away from claim 19's only NH_3 and N_2 etch gasses.

In contrast to amended claim 19's "etch process to etch said organic low k dielectric layer through said opening to form a first opening using said masking pattern as an etch mask; Ngo col. 4, lines 40-42 does not form a first opening. In contrast, Ngo only performs a "plasma treatment" See col. 4, lins 40 to 49; See col. 4, lines 5 -20. Ngo is a different step, previous step, forms an opening. See Ngo col. 5, lines 37 – 40.

Therefore, it is improper to cite Ngo as an etch step. Furthermore, Ngo does not met or suggest claim 19's etch step or chemistry.

Rejection of claims 20-21

The rejection of claims 20-21 is acknowledged. Claim 20 depends from non-obvious parent claim 19 as discussed above. Claim 20 claims non-obvious parameters.

Claim 21 contains non-obvious parameters.

Combination of Ye and Bhardwaj is improper.

The combination of Ye and Bhardwaj is improper. The combination of Ye and Bhardwai can only be done by hindsight. There is no suggestion to combine the references. The references teach incompatible processes and teach away from each other. The point Bhardwai is cited for, increasing the etch rate by varying every process parameter, is not related to the invention's object to increase the etch rate and straightness of the vertical walls of the opening. See spec. p. 12 lines 12 and claim 9.

Therefore, claims 20-21 are non-obvious.

Rejection of claim 26

Rejection of claim 26 is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the amendments.

Claim 26 depends form a non-obvious parent claim and is non-obvious.

Furthermore, the combination of reference is improper because there is no-motivation to combine than and they can only be combined by hindsight. Moreover, McReynolds teaches a total unrelated etch process of different material, different gases and different results.

New claims 27 and 28 are non-obvious

New claims 27 and 28 claim and etch with flowing NH_3 and N_2 etch gasses and flowing CO or O_2 gasses. These are non-obvious for the reasons stated above.

CONCLUSION

In conclusion, reconsideration and withdrawal of the rejections are respectfully requested. Allowance of all claims is requested. Issuance of the application is requested.

It is requested that the Examiner telephone the undersigned attorney George Saile at (845) 452-5863 should there be anyway that we could help to place this Application in condition for Allowance.

Respectfully submitted,

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Version with markings to show changes

Claims with amendments are shown marked up to shown amendments.

Claims not amended are not marked up.

1. (Amended) A method of fabrication of etching a low -k dielectric layer used in microelectronics fabrication; comprising the steps of :

a) forming an organic low k dielectric layer over a substrate;

b) forming a masking pattern over said organic low k dielectric layer; said masking pattern having an opening;

c) using an etch process to etch said organic low k dielectric layer through said opening to form a first opening using said resist pattern as an etch mask; said etch process comprising:

(1) in a first step, etching said organic low k dielectric layer by applying a plasma power and flowing at least NH_3 gas and flowing CO or O_2 gasses.

cancel claim 2

Cancel claim 3

4. (Amended) The method of claim 1 wherein said first step comprises applying a [medium] plasma power plasma density between 1E9 and 1E11 cm^{-3} and flowing [only] NH_3 gas, a power in between 500 and 1500 W, and a NH_3 flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing CO or O_2 gasses.

5. The method of claim 1 wherein said organic low k dielectric is comprised of a material selected from the group consisting of fluorinated arylether, Benzocyclobuthene (BCB), amorphous teflon, carbon doped oxides, poly arylene ether (PAE) and organic Spin on materials.

6. The method of claim 1 wherein said organic low k dielectric is comprised of a material selected from the group consisting of fluorinated arylether, and poly arylene ether.

7. The method of claim 1 wherein said organic low k dielectric is comprised of carbon doped oxide.

8. The method of claim 1 wherein said organic low k dielectric is comprised of poly arylene ether (PAE).

9. (Amended) The method of claim 1 wherein said etch forms [a] said first opening through said organic low k dielectric layer; said first opening having sidewalls defined by said organic low k dielectric layer; said sidewalls are substantially vertical at a angle between 87 and 93 degrees to the surface of the substrate; and said first step comprises applying a [medium] plasma power plasma density between 1E9 and 1E11 cm^{-3} and flowing NH_3 gas, a power in between 500 and 1500 W, and a NH_3 flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing CO or O_2 gasses.

10. The method of Claim 1 wherein the substrate is selected from the group consisting of: microelectronics conductor materials; microelectronics semiconductor materials; and microelectronics dielectric materials.

11. **(AMENDED)** A method of fabrication of etching a low -k dielectric layer, comprising the steps of :

a) forming an organic low k dielectric layer over an insulation layer over a substrate;

b) forming a masking pattern over said organic low k dielectric layer; said masking pattern having an opening;

c) using an etch process to etch said organic low k dielectric layer through said opening to form a first opening using said masking pattern as an etch mask; said etch process comprising:

(1) in a first step, etching said organic low k dielectric layer by applying a plasma power and flowing NH_3 and H_2 etch gasses and flowing O_2 or CO gasses.

cancel claim 12

13. **(Amended)** The method of claim 11 wherein said first step comprises:

a plasma power between 500 and 1500 W, [medium] plasma power plasma density between 1E9 and 1E11 cm^{-3}, a NH_3 flow between 50 and 300 sccm, a H_2 flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing O_2 or CO gasses.

14. **(Amended)** The method of claim [1] 11 wherein said organic low k dielectric is comprised of a material selected from the group consisting of fluorinated arylether, Benzocyclobuthene (BCB), amorphous teflon, carbon doped oxides, poly arylene ether (PAE) and organic Spin on materials.

15. The method of claim 11 wherein said organic low k dielectric is comprised of a material selected from the group consisting of fluorinated arylether, and poly arylene ether.

16. The method of claim 11 wherein said organic low k dielectric is comprised of carbon doped oxide.

17. The method of claim 11 wherein said organic low k dielectric is comprised of poly arylene ether (PAE).

18. (Amended) The method of claim 11 wherein said etch forms [a] said first opening through said organic low k dielectric layer; said first opening having sidewalls defined by said organic low k dielectric layer; said sidewalls are substantially vertical at a angle between 87 and 93 degrees to the surface of the substrate; and said first step comprises:

a plasma power between 500 and 1500 W, plasma power plasma density between 1E9 and 1E11 cm^{-3}, a NH_3 flow between 50 and 300 sccm, a H_2 flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing O_2 or CO gasses.

19. **(Amended)** A method of fabrication of etching a low -k dielectric layer; comprising the steps of:

a) forming an organic low k dielectric layer over a insulation layer over a substrate;

b) forming a masking pattern over said organic low k dielectric layer; said masking pattern having an opening;

c) using an etch process to etch said organic low k dielectric layer through said opening to form a first opening using said masking pattern as an etch mask; said etch process comprising:

(1) in a first step, etching said organic low k dielectric layer by applying a plasma power and flowing only NH_3 and N_2 etch gasses.

20. (Amended) The method of claim 19 wherein said first step comprises:

power in between 500 and 1500 W, [medium] plasma power plasma density between 1E9 and 1E11 cm^{-3}, a NH_3 flow between 50 and 300 sccm and a N_2 flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr.

21. (Amended) The method of claim 19 wherein said first step comprises:

power in between 500 and 1500 W, [medium] plasma power plasma density between 1E9 and 1E11 cm^{-3}, a NH_3 flow between 50 and 300 sccm and a N_2 flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing CO or O_2 gasses.

22. The method of claim 19 wherein said organic low k dielectric is comprised of a material selected from the group consisting of fluorinated arylether, Benzocyclobuthene (BCB), amorphous teflon, carbon doped oxides, poly arylene ether (PAE) and organic Spin on materials.

23. The method of claim 19 wherein said organic low k dielectric is comprised of a material selected from the group consisting of fluorinated arylether, and poly arylene ether.

24. The method of claim 19 wherein said organic low k dielectric is comprised of carbon doped oxide.

25. The method of claim 19 wherein said organic low k dielectric is comprised of poly arylene ether (PAE).

26. (Amended) The method of claim 19 wherein said etch forms [an] <u>said</u> first opening through said organic low k dielectric layer; said first opening having sidewalls defined by said organic low k dielectric layer; said sidewalls are substantially vertical at a angle between 87 and 93 degrees to the surface of the substrate.

Please add new claims as follows

27 A method of fabrication of etching a low -k dielectric layer; comprising the steps of:

a) forming an organic low k dielectric layer over a insulation layer over a substrate; said organic low k dielectric is comprised of a material selected from the group consisting of fluorinated arylether, Benzocyclobuthene, amorphous teflon, carbon doped oxides, and organic Spin on materials.

b) forming a masking pattern over said organic low k dielectric layer; said masking pattern having an opening;

c) using an etch process to etch said organic low k dielectric layer through said opening to form a first opening using said masking pattern as an etch mask; said etch process comprising:

(1) in a first step, etching said organic low k dielectric layer by applying a plasma power and flowing NH_3 and N_2 etch gasses and flowing CO or O_2 gasses.

28. The method of claim 27 wherein said first step comprises:

power in between 500 and 1500 W, plasma power plasma density between 1E9 and 1E11 cm^{-3}, a NH_3 flow between 50 and 300 sccm and a N_2 flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing CO or O_2 gasses.

29. The method of claim 27 wherein said first step comprises:

power in between 500 and 1500 W, plasma power plasma density between 1E9 and 1E11 cm^{-3}, a NH_3 flow between 50 and 300 sccm and a N_2 flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing CO or O_2 gasses; and

said etch forms said first opening through said organic low k dielectric layer; said first opening having sidewalls defined by said organic low k dielectric layer; said sidewalls are substantially vertical at a angle between 87 and 93 degrees to the surface of the substrate.